

*High Capacity
Recordable Disc Systems*

System Description

Version 1.1

August 2006

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High Capacity Recordable Disc Systems

Table of Contents

Version 1.1

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1. General

This document describes the High Capacity Recordable Disc System, indicated in this document as HC-R. The HC-R Disc System is based on the CD-R specification Orange Book, part II, Volume 2. This document describes only the modified specifications towards this CD-R specification, both for recorded and unrecorded discs.

The recorded High Capacity Recordable disc has a higher information density than conventional CD-R discs.

1.1 Scope

The HC-R Disc System gives the opportunity to write once and read many times CD information. The recorded High Capacity Recordable disc is almost 'Red Book compatible', so it can be played back on most conventional CD-players. The HC-R Disc System format gives the possibility for both Audio and Data recording.

1.2 General Description

This document defines High Capacity discs with a maximum single session disc recording time of 98 minutes, 29 seconds, 74 frames of 12cm discs. Corresponding disc capacity is roughly 865 MB (1 MB = 2^{20} Byte). For 8 cm discs playing time and disc capacity corresponds with roughly 30 minutes and 260 MB.

Warning 1:

After recording, the HC-R disc satisfies most specifications as written in the chapter DISC SPECIFICATION of the Red Book. Read and/or write compatibility with drives that carry a CD and/or a CD-R logo can however not be guaranteed. Philips and SONY will not take any responsibility for any data lost in those cases.

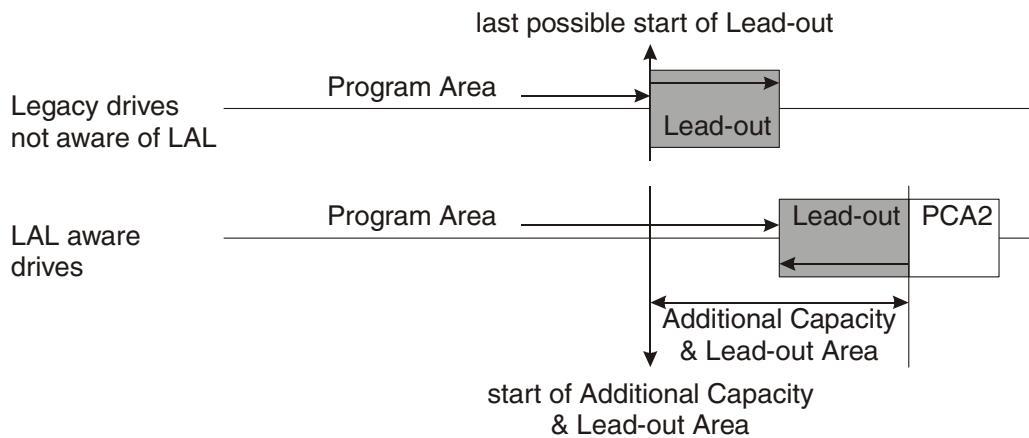
Warning 2:

Due to technical reasons, it may be the case that during playback and recording at high rotation speed the disc and drive suffers significant technical damage.

Therefore, sufficient care should be taken by the disc manufacturer to produce discs allowing recording and playback at high rotation speed, even after rough disc handling.

Sufficient care should be taken by the drive manufacturer to guarantee that the loading-tray is closed, and remains to be so, during playback and during recording.

Disc capacity on conventional CD-R discs is limited to 79 minutes, 59 seconds and 74 frames. Additional disc capacity for 12cm discs can be implemented by expanding the "Additional Capacity & Lead-out Area" to a maximum of 20 minutes as described in Chapter 3. The length of this area is indicated as the "Length of Additional Capacity & Lead-out Area" (LAL) in the Additional Information 1 ATIP code.



For 8 cm HC-R discs the default LAL is 2 minutes. The basic disc capacity of an 8 cm disc is indicated by "Start of Additional Capacity & Lead-out Area" (SAL).

Remark:

Legacy drives that are not aware of SAL and LAL, introduced by Orange Book Part II, Volume 2, Version 1.1, will not use the additional disc capacity as indicated by LAL. These drives will interpret SAL as latest start of lead-out, which is maximum 79:59:74.

1.3 References and conformance

HC-R conforms to the mandatory requirements specified in the Orange Book part II, Vol. 2. All parts in this document are mandatory unless they are specially defined as recommended or optional or informative.

Note:

Due to advances in technology and market requirements, System Descriptions might need to be extended after some time. This could mean that new items, such as e.g.: new subcode modes and pointers, new ATIP formats, new data structures or definitions for reserved bits/bytes, may have to be added to a System Description.

System designers should take notice of this in the design of their equipment.

HC-R also conforms to the applicable parts of the System Descriptions or international standard that are listed below:

Reference measurement Methods, Compact Discs, Reference measurement Methods, Specification Guidelines, Version 1.0, May 1999

1.4 Definitions

Definitions used in this document are conforming the definitions used in Orange Book part II Vol. 2, Chapter I.4.

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2. HC-R Disc Specification

2.1 General

The HC-R disc specification fulfills the requirements as written in the DISC SPECIFICATION of the Red Book and Orange Book (Vol. 2, Version 1.2), **except for** the items specified in Chapters II of this document.

2.2 Conditions for Multi-Speed Media testing at low speeds

See Orange Book Part II, Vol. 2.

2.3 Conditions for Multi-Speed Media testing at high speeds

See Orange Book Part II, Vol. 2.

2.4 The unrecorded disc

- The paragraphs mentioned in this chapter 2.4 **replace** the paragraphs with the same numbering of the Red Book.

| characteristic to be specified | requirement | remarks |
|--------------------------------|--|--|
| 9 Information Area | | |
| 9.1 Start time: | Start time is 1 minute (ATIP) before the start time of the Lead-in Area. | Corresponding start diameter: 44.8 mm. |

2.5 The recorded disc

- The recorded HC-R disc fulfills all requirements as written in the chapter: "DISC SPECIFICATION" of the Red Book, unless otherwise stated in this chapter.
- The data on the disc has been recorded at the testing speeds defined in Orange Book part II, Volume 2, Chapter IV.4.4.
- All parameters are specified for playback at 1x nominal CD speed, according to the Red Book. Measurements could be performed at other speeds with appropriate scaling of the results.

| characteristic to be specified | requirement | remarks |
|---------------------------------------|-----------------|--|
| 9 Information Area | | |
| 9.1 Starting diameter of program area | 49.4-50.0 mm | |
| 9.3 Starting diameter of Lead-in Area | 46 +0.2/-0.3 mm | Corresponding start time indicated in ATIP during the Lead-in area (see chapter IV.4 Orange Book part II, Vol. 2, Version 1.2) |
| 10 Track pitch | | |
| 10.1 Track pitch | 1.28 – 1.5 µm | |

| | | |
|-----------------------------------|--|--|
| 11 Rotation | | |
| 11.2 Scanning velocity | 1.13 – 1.20 m/s | |
| 14 HF signal | | |
| 14.1 I3/Itop | 0.25 – 0.70 | |
| 14.7 Jitter and effect length | Jitter < 40ns effect length: see Red Book | To increase readout compatibility it is strongly recommended to apply an MTF filter for readout of HC-R discs. See example in Reference measurement Methods, May 1999 |
| 15 Radial tracking signals | | |
| 15.1 Push Pull magnitude | 0.06 - 0.12 | |
| 15.4.1 Radial Contrast | 0.25 – 0.60 | See attachment XIII.6 and XIII.8 of Orange Book Vol. 2. |

3. Requirements & recommendations for CD-Recorder

See Orange Book Part II, Vol 2.

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4. Pre-groove modulation, ATIP

4.1 General parameters

See Orange Book Part II, Vol 2.

4.2 FM modulation

See Orange Book Part II, Vol 2.

4.3 Frame format

See Orange Book Part II, Vol 2.

4.4 Data format

To facilitate time codes over 99:59:74, the most significant nibble of the Minutes Field shall count binary instead of BCD.

Example:

| Minutes | | Seconds | | Frames | |
|---------|-----|---------|-----|--------|-----|
| Binary | BCD | BCD | BCD | BCD | BCD |
| : | : | : | : | : | : |
| 9 | 9 | 5 | 9 | 7 | 3 |
| 9 | 9 | 5 | 9 | 7 | 4 |
| A | 0 | 0 | 0 | 0 | 0 |
| A | 0 | 0 | 0 | 0 | 1 |
| : | : | : | : | : | : |

4.4.1 Special Information 1

See Orange Book Part II, Vol 2.

4.4.2 Special Information 2

See Orange Book Part II, Vol 2.

4.4.3 Special Information 3

See Orange Book Part II, Vol 2.

4.4.4 Additional Information 1

4.4.4.1 Lowest Test Speed L1..L3

See Orange Book Part II, Vol 2.

4.4.4.2 Highest Test Speed H1..H4

See Orange Book Part II, Vol 2.

4.4.4.3 High Speed subtype I1..I3

See Orange Book Part II, Vol 2.

4.4.4.4 Optimum β range C1..C2

See Orange Book Part II, Vol 2.

4.4.4.5 Optimum pulse range N1..N3

See Orange Book Part II, Vol 2.

4.4.4.6 Length of Additional Capacity & Lead-out Area : E1..E4

These 4 bits specify the Additional Capacity & Lead-out area length and the location of PCA2 by means of an offset relative to the Start Time of the Additional Capacity & Lead-out Area.

| M1 | S1 | F1 |
|----|----|---------------|
| 0 | 0 | 1 E1 E2 E3 E4 |

| | | | |
|--------|---|-------------------|------------------------|
| E1..E4 | = | 0000 : 2 minutes | Default for 8 cm discs |
| | | 0001 : 4 minutes | |
| | | 0010 : 6 minutes | |
| | | 0011 : 8 minutes | |
| | | 0100 : 10 minutes | |
| | | 0101 : 12 minutes | |
| | | 0110 : 14 minutes | |
| | | 0111 : 16 minutes | |
| | | 1000 : 18 minutes | |
| | | 1001 : 20 minutes | |
| | | Others: reserved | |

Remark:

ATIP Time codes between 95:00:00 and 99:59:74 may occur twice on a 12 cm. disc (inner area and outer radius) when E1..E4 defines a LAL area larger than 14 minutes. It is strongly recommended that a recorder be designed such that it can handle two identically coded time area's on such discs.

4.4.4.7 Additional Information 2

See Orange Book Part II, Vol 2.

4.4.4.8 Additional Information 3

See Orange Book Part II, Vol 2.

5. List of Changes

Differences between Recordable Disc Systems High Capacity Recordable Disc Systems, Version 1.0, April 2003 and High Capacity Recordable Disc Systems, Version 1.1, August 2006.

Main changes:

- Reference to Orange Book part II Volume 2 Version 1.2 has been modified to Orange Book part II Volume 2.

| Page | V1.0 | V1.1 | Remarks: |
|------------------|---|---|-----------|
| 3 | Definitions used in this document are conforming the definitions used in Orange Book part II Vol. 2, Version 1.2 Chapter I.4. | Definitions used in this document are conforming the definitions used in Orange Book part II Vol. 2, Chapter I.4. | Editorial |
| 5 (two times) | See Orange Book Part II, Vol. 2, Version 1.2 | See Orange Book Part II, Vol. 2. | Editorial |
| 6 | See attachment XIII.6 and XIII.8 of Orange Book Vol. 2, Version 1.2 | See attachment XIII.6 and XIII.8 of Orange Book Vol. 2. | Editorial |

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